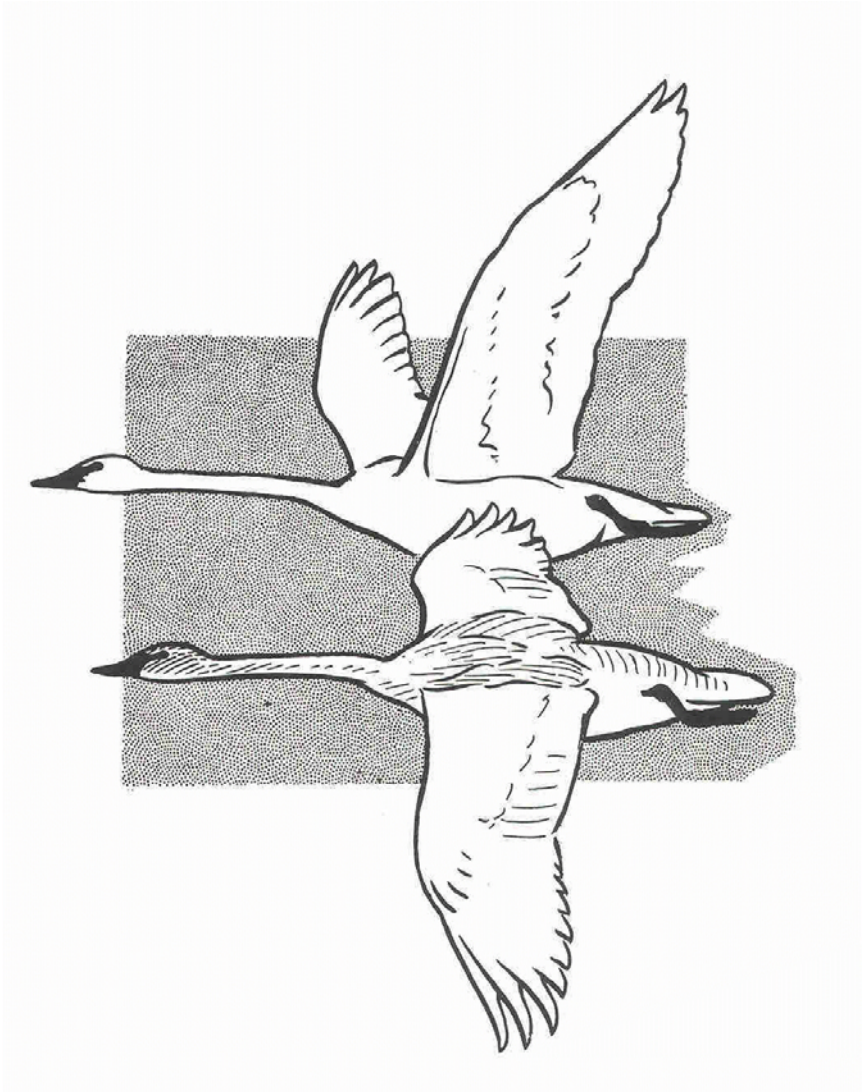
TRUMPETER SWAN SURVEY
of the
ROCKY MOUNTAIN POPULATION

WINTER 2006



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ROCKY MOUNTAIN POPULATION

WINTER 2006

U.S. Fish and Wildlife Service
Migratory Birds and State Programs
Mountain-Prairie Region
Lakewood, Colorado

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Abstract.– Observers counted 5,484 swans (white birds and cygnets) in the Rocky Mountain Population of trumpeter swans during February 2006, an increase of 2% from the 5,361 counted in February 2005 and the third consecutive record-high count for the Mid-winter Survey. The numbers of white birds (4,261) and cygnets (1,223) increased 1% and 6%, respectively, from counts last year. In the tri-state area, increases in total swans occurred in Montana (+47%) and Wyoming (+2%), but decreased slightly in Idaho (-5%). The number of birds wintering in areas near restoration flocks was slightly higher than the count last year. The number of swans counted in Oregon (50) was higher than that of last year and the 1997-2005 average. However, the count at Ruby Lake NWR was the lowest since 1994, and only about half of that observed during the mid- to late-1990s. The drought conditions that persisted in much of the tri-state area during the last several years abated somewhat, and reservoir levels in early February increased 19% from the very low levels recorded during 2004. Generally, temperatures during winter 2005-06 were slightly warmer than average, although temperatures dropped sharply in many areas of the tri-state region during February. Precipitation in primary winter areas was much above average from December 2005 through February 2006.

The Rocky Mountain Population (RMP) of trumpeter swans (*Cygnus buccinator*) consists of birds that nest primarily from western Canada southward to Nevada and Wyoming (Fig. 1). The population is comprised of several flocks that nest in different portions of the overall range. The RMP/Canadian Flocks consist of birds that summer primarily in southeastern Yukon Territory, southwestern Northwest Territories, northeastern British Columbia, Alberta, and western Saskatchewan. The RMP/Tri-state Area Flocks summer in areas at the juncture of the boundaries of Montana, Wyoming, and Idaho (hereafter termed the tri-state area) and nearby areas (Fig. 2). The Canadian and Tri-state Area flocks winter sympatrically primarily in the tri-state area. In addition, efforts have been made to establish several RMP restoration flocks, such as those at Ruby Lake National Wildlife Refuge (NWR) in Nevada (i.e., Nevada flock) and those at Malheur NWR and Summer Lake Wildlife Management Area (WMA) and vicinity (i.e., Oregon flock), by translocating adult swans and cygnets from other portions of the RMP. These birds tend to winter in areas near those where they nest. These terms for the various groups of swans are consistent with the RMP Trumpeter Swan Implementation Plan (Pacific Flyway Study Committee 2002).

Although counts of swans wintering in the tri-state area have been conducted since at least the 1950s (Banko 1960), many early efforts were not well-coordinated and were variable. In an attempt to better coordinate the survey, in 1972 the U.S. Fish and Wildlife Service (Service) began the annual Mid-winter Trumpeter Swan Survey in the tri-state region. During the next decade, the area surveyed increased substantially, and by 1981 it was believed all known occupied wintering sites were included (Gale et al. 1988). Recent attempts to expand the wintering range of RMP trumpeter swans has resulted in the inclusion of yet more areas to the survey. Also, some areas may not be surveyed in a particular year due to weather or resource limitations (e.g., staff, money). Such survey modifications make individual counts from year-to-year less comparable, but the data are sufficient to reasonably depict trends in abundance.

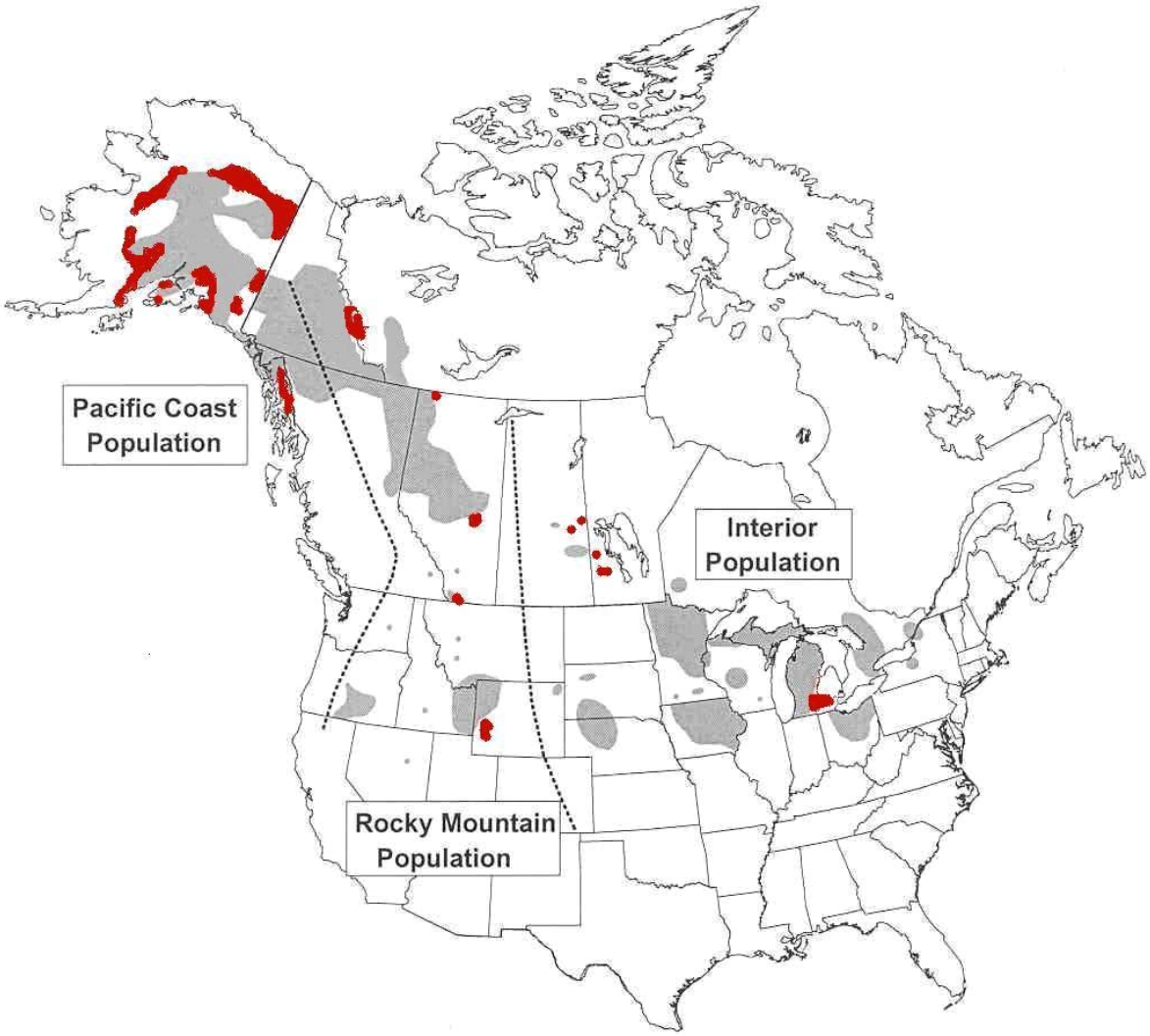

Fig. 1. Approximate ranges of trumpeter swans during summer. Range expansions reported by survey biologist during the 2005 North American trumpeter swan survey are shown in black (from Moser 2006).

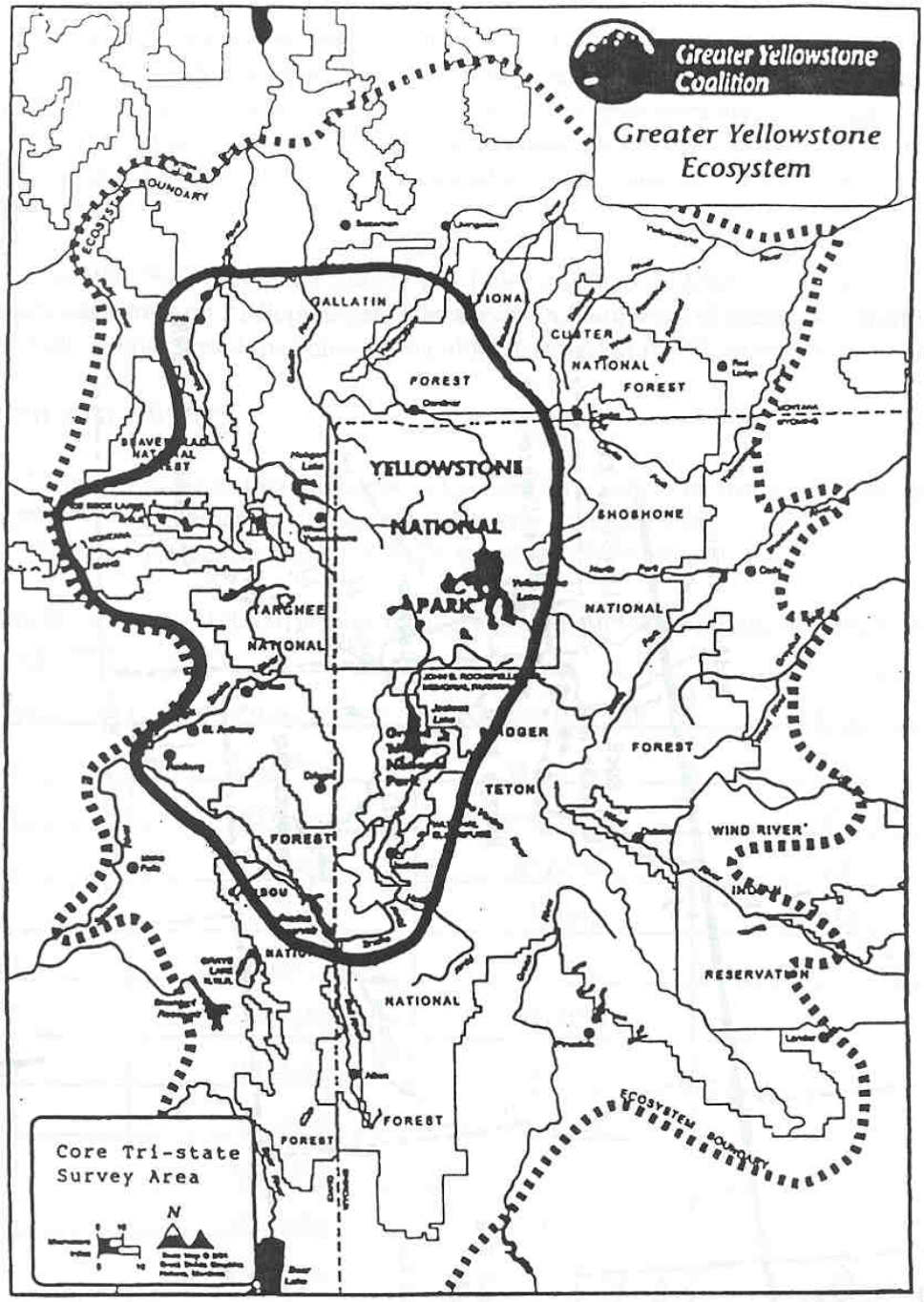

Fig. 2. Map showing the 'core' tri-state area of southeast Idaho, southwest Montana, and northwest Wyoming (provided by the Greater Yellowstone Coalition, Bozeman, Montana).

The Mid-winter Trumpeter Swan Survey is conducted annually in late January or early February. The survey is conducted cooperatively by several administrative entities and is intended to provide an annual assessment of the number of RMP trumpeter swans. Only data from 1972 to present, the time frame during which the Service has coordinated the survey, were analyzed for this report.

METHODS

The survey generally is conducted within a relatively short time frame (i.e., 1 week) to reduce the possibility of counting swans more than once due to movements of birds among areas. Aerial cruise surveys were used to count numbers of swans in the tri-state area and in the Summer Lake WMA and vicinity; ground surveys were used to count the number of swans in Nevada, at Malheur NWR and in isolated pockets of habitat not covered by aerial surveys. During aerial surveys, data are collected by observers seated in a single-engine, fixed-winged aircraft. Flying altitude varies with changes in terrain and surface winds, but generally averages 30-60 m above ground level, and flight speed is between 135-155 kph. One to two observers and the pilot count white (i.e., adults and subadults) and gray (i.e., cygnets) swans in known or suspected habitats. Counts are not adjusted for birds present but not seen by aerial crews, and have an unknown and unmeasured sampling variance associated with them. Ground surveys are used to verify species composition of some swan flocks, because trumpeter and tundra (*C. columbianus*) swans are difficult to differentiate during aerial surveys. Efforts are made to identify and exclude tundra swans from the survey counts.

Annual estimates of abundance for Canadian Flocks are determined by subtracting the count of the RMP/U.S. Breeding Segment in the previous fall (e.g., U.S. Fish and Wildlife Service 2005*a*) from the Mid-winter count. For the estimate of the size of the Canadian Flocks to be accurate, several conditions must be met. First, all swans must be correctly identified to species. Second, the Mid-winter count and the fall count of swans in the RMP/U.S. Breeding Segment must be accurate. Additionally, we must assume that mortality in the RMP/U.S. Breeding Segment between the time of the fall and winter surveys is negligible. Because of problems inherent in surveying biological populations, these conditions probably are seldom met. Thus, this methodology for estimating the size of the RMP/Canadian Flocks likely leads to somewhat biased estimates of the composition of the RMP. However, we assume that these possible inaccuracies, if they occur, are random.

During fall and winter 2005-06, the quinquennial rangewide survey of trumpeter swans also was conducted. This survey attempts to conduct a complete census of all trumpeter swans in North America (Moser 2006). Every 5 years, the results of this survey allow the opportunity to compare our annual estimate of the number of birds in the Canadian flocks, derived from subtraction, to actual estimates of those birds on their nesting range.

To assess production for the RMP, we calculated the percentage of annual total swan counts that were cygnets. However, surveys in Nevada and Oregon did not separate counts into white birds and cygnets until 1992. Therefore, to allow an assessment over a longer time frame with data that are relatively comparable from year-to-year, we used only information from birds counted in the tri-state

region. This subset contained a large majority (range = 87%-99%, $\bar{x}$ = 95%) of the total RMP counts during 1972-2005. Counts used for analyses in this report are provided in Appendix A.

RESULTS AND DISCUSSION

The 2006 Mid-winter survey was conducted between 25 January and 11 February. Weather conditions were favorable for conducting surveys in most areas. Generally, skies were clear with light winds and good-to-excellent visibility. However, the weather was variable in Idaho, where conditions were sometimes poor with strong winds. These conditions required survey crews to spread their effort over several days. Nonetheless, visibility was fair to excellent when the survey was being conducted. Approximately 26 h of flight time and additional ground survey time were required to complete the survey. Most of the areas typically visited during the Mid-winter survey were surveyed this year.

Precipitation during December to February was 125% to 200% of average throughout much of the tri-state area (Joint Agricultural Weather Facility 2006), resulting in much better moisture conditions than during recent winters. Water levels at 5 reservoirs (American Falls, Island Park, Jackson Lake, Palisades, and Minidoka Dam/Lake Walcott) cumulatively were at 59% of storage capacity on February 1 (data from U.S. Bureau of Reclamation 2006*a*), 19% above the very low level of last year and only 3% below the 1972-2005 average. Together, these reservoirs comprise about 97% of the water-storage capacity for reservoirs listed in the Snake River Basin in eastern Idaho and extreme western Wyoming (U.S. Bureau of Reclamation 2006*b*). Snowpack as of 1 February throughout much of the tri-state area was about 110-150% of normal, and >150% of normal in central Oregon and portions of northeastern Nevada (U.S. Department of Agriculture 2006).

The average streamflow on the Henrys Fork near Island Park Reservoir, Idaho, during 15 January to 15 February 2006 was 389 cfs, essentially identical to the 1972-2005 average for that recording station (U.S. Bureau of Reclamation 2006*a*) (Fig. 3). Although highly variable during December-February, the temperatures in the tri-state area during winter were slightly warmer than average (Fig. 4). Temperatures dropped sharply in February, and set record lows in several areas within the tri-state region (Joint Agricultural Weather Facility 2006).

Historical Trends

Methods used to estimate trends in rates of change in RMP abundance were detailed in a previous report (U.S. Fish and Wildlife Service 2003), and will not be reiterated here. Briefly, however, we used least-squares regression on log-transformed counts to assess rates of change in counts of swans over time. Counts from the current Mid-winter survey (2006) were compared to results from 1972-2005, a practice used in Service survey reports for other waterfowl (e.g., Wilkins et al. 2005, U.S. Fish and Wildlife Service 2005*b*). Because Nevada and Oregon did not separate total counts of swans into white birds and cygnets prior to 1992 (see above), analyses to assess trends for white birds and cygnets used only counts from the tri-state area.

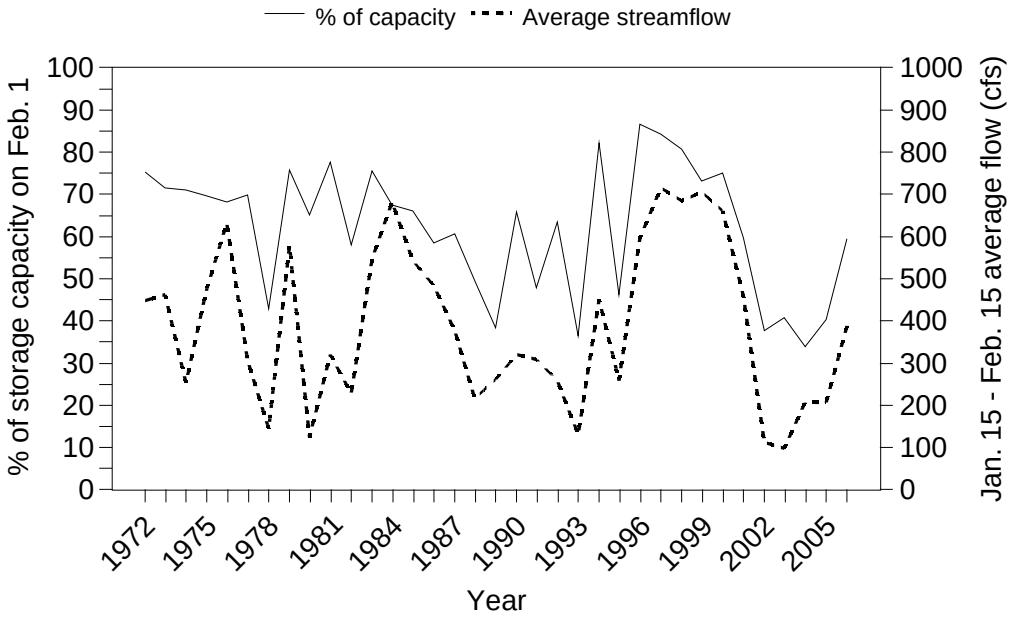

Fig. 3. Water storage for 5 reservoirs (see text) in the tri-state region on 1 February, and average streamflow between 15 January and 15 February on the Henrys Fork, 1972-2006.

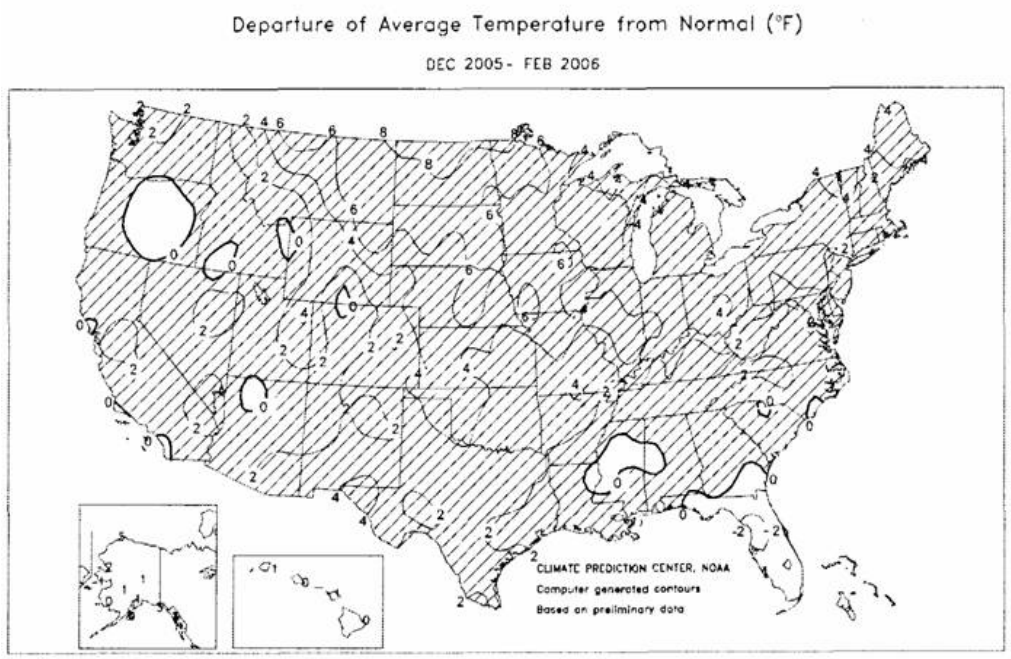

Fig. 4. Departure of temperatures from normal during winter 2005-06 (Joint Agricultural Weather Facility 2006).

The counts for total swans of the RMP suggested an increase ($P < 0.01$) of about 6.1% per year during 1972-2005 (Table 1, Fig. 5). The number of white birds and cygnets counted in the tri-state region both increased ($P < 0.01$) at 6.0% per year. Counts of birds in Montana (white birds + cygnets) increased slightly (+1.8% per year, $P < 0.01$), whereas rates of growth for birds wintering in Idaho and Wyoming were much higher (+7.5% per year for each state)(Table 2, Fig. 6). Although the number of birds wintering in each of the 3 states in the tri-state region generally have increased since 1972, the distribution of birds among the states has changed substantially. Whereas during the 1970s and early 1980s about 36% of wintering swans were counted in Montana, only about 13% of the birds wintering in the tri-state area have been counted there during the last decade (Fig. 7). In contrast, the percentage of birds in Idaho has increased from about 53% to about 68% during that same time period. The percentage of birds counted in Wyoming during winter also has increased slightly, from about 11% to 19%.

Counts of total swans wintering in Nevada have fluctuated over time, but suggest an increase ($P = 0.01$) of about 1.3% per year during 1972-2005 (Table 2, Fig. 8). Counts in Nevada during the early 2000s generally were near historic highs. Trumpeter swans in Oregon primarily occur in 2 areas, Malheur NWR and the Summer Lake WMA and vicinity. Introductions of trumpeter swans to Malheur NWR began in the late 1930s, whereas birds were not translocated to Summer Lake WMA until the winter of 1992. Analyzing trends for the Oregon Flock as a whole (Table 2) could lead to inappropriate inferences. Therefore, we analyzed data for Malheur NWR (1972-2005) separate from those for Summer Lake WMA. Results suggest a decline (-2.6% per year, $P = 0.05$) for birds wintering at Malheur NWR (Fig. 8, Appendix A). At Summer Lake WMA, most birds were translocated to the area during winter, and generally remained in the area for only a few months after being translocated (M. St. Louis, personal communication). Thus, in 1997, the winter following the termination of translocations to Summer Lake WMA, the number counted during the survey dropped sharply (Fig. 8). From 1997-2005, an average of about 25 birds have been observed during winter surveys (excluding years with incomplete surveys).

The percentage of the entire RMP estimated to be comprised of Canadian Flocks increased from about 19% during February of 1972 to 92% during February 2005 (Table 3). The data fit a 2nd-order logarithm model ($P < 0.01$, adjusted $R^2 = 0.96$), suggesting that the percentage may be approaching a plateau value near 90% (Fig. 9). The number of swans estimated to be from Canadian Flocks exhibited a fairly steady increase since the early 1980s, and was nearly 5,000 birds in 2005 (Table 3, Fig. 9).

Results from the 2006 survey

During February 2006, observers counted 5,484 trumpeter swans in the RMP, an increase of 2% from the count of last February (5,361) and the third consecutive record-high count for the Mid-winter Survey (Table 1). The number of white birds and cygnets increased 1% and 6%, respectively, from counts last year. The number of swans wintering in the tri-state area increased 2%, which also

Table 1. Counts of trumpeter swans of the Rocky Mountain Population during winter, 1972-2006.

	Tri-state area			Oregon and Nevada[a]			Total RMP		
Year	White birds	Cygnets	Total	White birds	Cygnets	Total	White birds[b]	Cygnets[b]	Total
1972	c	c	616			91			707
1973	c	c	581[d]			60			641
1974	553	156	709			61			770
1975	595	128	723			40			763
1976	623	102	725			55			780
1977	839	178	1017			46			1063
1978	695	179	874			27			901
1979	743	123	866			62			928
1980	767	172	939			86			1025
1981	1000	247	1247			98			1345
1982	952	266	1218			105			1323
1983	1025	207	1232			90			1322
1984	1128	332	1460			98			1558
1985	1326	190	1516			82			1598
1986	1304	299	1603			59			1662
1987	1196	386	1582			77			1659
1988	1314	408	1722			51			1773
1989	1452	291	1743			54			1797
1990	1591	416	2007			38			2045
1991	1589	342	1931			49			1980
1992	1642	397	2039	99	58	157	1741	455	2196
1993	1659	419	2078	121	36	157	1780	455	2235
1994	1753	543	2296	127	101	228	1880	644	2524
1995	2012	668	2680	93	30	123	2105	698	2803
1996	2129	580	2709	163	64	227	2292	644	2936
1997	2179	407	2586	77	18	95	2256	425	2681
1998[e]	1756	307	2063	64	29	93	1820	336	2156
1999	2698	772	3470	45[f]	10[f]	71	2743[f]	782[f]	3541
2000	2694	746	3440	50[f]	15[f]	84	2744[f]	761[f]	3524
2001	3198	719	3917	47[f]	11[f]	90	3245[f]	730[f]	4007
2002	3814	546	4360	48[f]	7[f]	67	3862[f]	553[f]	4427
2003[g]	3365	532	3897	62	15	77	3427	547	3974
2004[g]	3785	746	4531	46	7	53	3831	753	4584
2005	4147	1143	5290	59	12	71	4206	1155	5361
2006	4203	1209	5412	58	14	72	4261	1223	5484

[a] Total counts not separated into white birds and cygnets prior to 1992.

[b] Not calculated prior to 1992 because of no counts for Oregon and Nevada.

[c] Not provided because counts for Yellowstone National Park not separated into white birds and cygnets.

[d] In Wyoming only Yellowstone National Park surveyed.

[e] 1998 counts for the Tri-state area and Total RMP are biased low because aerial survey of Yellowstone National Park not conducted due to hazardous weather; counted by snowmobile with incomplete coverage.

[f] Counts biased low because white-bird and cygnet counts for Malheur NWR not available.

[g] Oregon/Nevada and Total RMP counts biased low due to incomplete surveys at Summer Lake WMA.

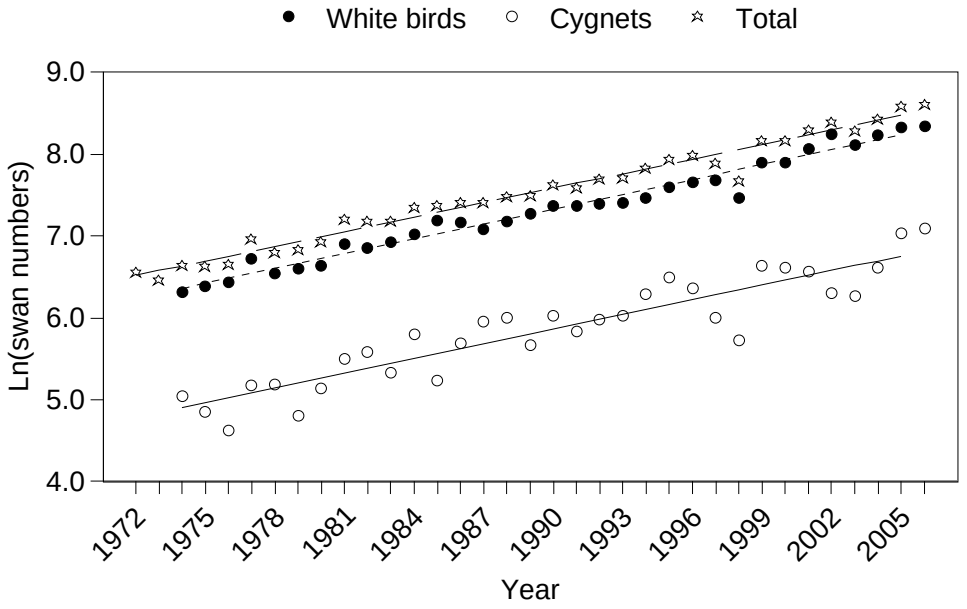

Fig. 5. Rates of change for counts of swans in the RMP during the Mid-winter Trumpeter Swan Survey, 1972-2006 (dotted and solid lines depict trends for white birds and cygnets, respectively, for swans counted in the tri-state region [see text]; dashed line depicts total RMP swans).

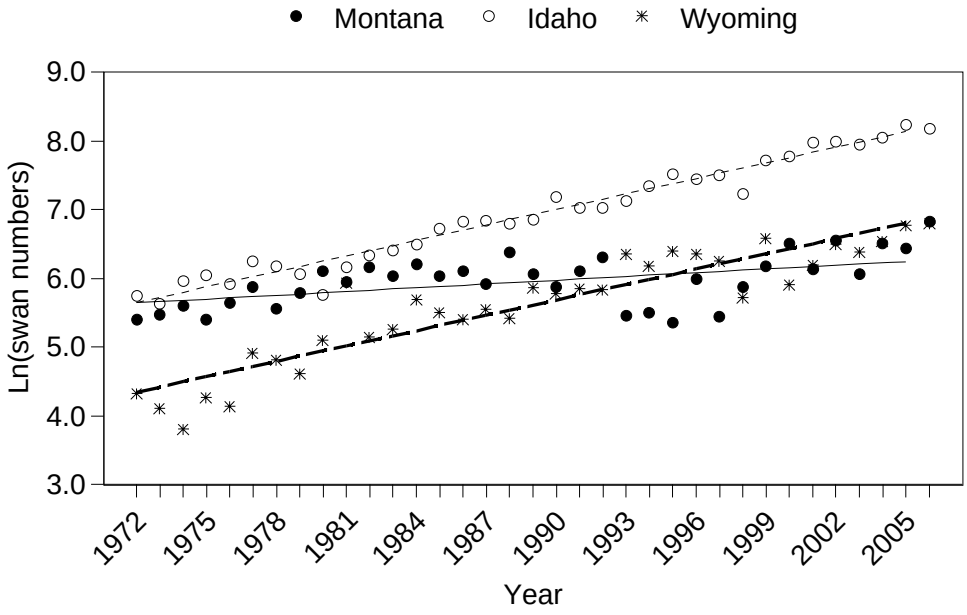

Fig. 6. Rates of change for counts of total swans in states of the tri-state region during the Mid-winter Trumpeter Swan Survey, 1972-2006 (solid, dotted, and dashed lines represent trends for Montana, Idaho, and Wyoming, respectively).

Table 2. Counts of trumpeter swans of the Rocky Mountain Population in individual states during winter, 1972-2006.

	Montana			Idaho			Wyoming			Oregon[a]			Nevada[a]		
Year	White birds	Cygnets	Total	White birds	Cygnets	Total	White birds	Cygnets	Total	White birds	Cygnets	Total	White birds	Cygnets	Total
1972	209	14	223	303	14	317	b	b	76			50			41
1973	212	28	240	222	58	280	b	b	61[c]			32			28
1974	233	40	273	282	109	391	38	7	45			36			25
1975	192	32	224	333	94	427	70	2	72			15			25
1976	253	34	287	308	67	375	62	1	63			30			25
1977	315	43	358	395	126	521	129	9	138			17			29
1978	194	68	262	392	96	488	109	15	124			7			20
1979	304	26	330	353	81	434	86	16	102			41			21
1980	374	80	454	250	70	320	143	22	165			65			21
1981	352	36	388	370	110	480	278	101	379			77			21
1982	390	90	480	429	137	566	133	39	172			65			40
1983	363	59	422	493	122	615	169	26	195			52			38
1984	389	109	498	503	162	665	236	61	297			63			35
1985	393	31	424	701	144	845	232	15	247			51			31
1986	380	73	453	744	183	927	180	43	223			33			26
1987	314	63	377	690	255	945	192	68	260			49			28
1988	438	153	591	694	209	903	182	46	228			24			27
1989	342	90	432	817	141	958	293	60	353			36			18
1990	319	38	357	1025	300	1325	247	78	325			23			15
1991	385	70	455	918	211	1129	286	61	347			31			18
1992	438	114	552	892	249	1141	312	34	346	67	56	123	32	2	34
1993	168	70	238	1020	246	1266	471	103	574	91	36	127	30	0	30
1994	199	48	247	1164	397	1561	390	98	488	114	94	208	13	7	20
1995	153	61	214	1391	475	1866	468	132	600	72	27	99	21	3	24
1996	319	82	401	1336	390	1726	474	108	582	140	49	189	23	15	38
1997	204	30	234	1555	272	1827	420	105	525	46	9	55	31	9	40
1998	290	68	358	1200	200	1400	266[d]	39[d]	305[d]	31	7	38	33	22	55
1999	335	153	488	1754	500	2254	609	119	728	16[e]	2[e]	34	29	8	37
2000	519	155	674	1881	513	2394	294	78	372	15[e]	6[e]	40	35	9	44
2001	373	96	469	2404	549	2953	421	74	495	16[e]	7[e]	55	31	4	35
2002	600	104	704	2636	357	2993	578	85	663	7[e]	5[e]	24	41	2	43
2003	375	58	433	2490	382	2872	500	92	592	28[f]	8[f]	36[f]	34	7	41
2004	583	92	675	2591	563	3154	611	91	702	8[f]	0[f]	8[f]	38	7	45
2005	508	119	627	2954	828	3782	685	196	881	27	10	37	32	2	34
2006	713	211	924	2714	873	3587	776	125	901	36	14	50	22	0	22

[a] Counts for Oregon and Nevada were not separated into white birds and cygnets until 1992.

[b] Not provided because counts for Yellowstone National Park not separated into white birds and cygnets.

[c] Counts for Yellowstone National Park only; remainder of Wyoming not surveyed.

[d] Counts for Wyoming biased low because aerial survey of Yellowstone National Park not conducted due to hazardous weather; counted by snowmobile with incomplete coverage.

[e] Counts biased low because white-bird and cygnet counts for Malheur NWR not available.

[f] Counts biased low due to incomplete surveys at Summer Lake WMA.

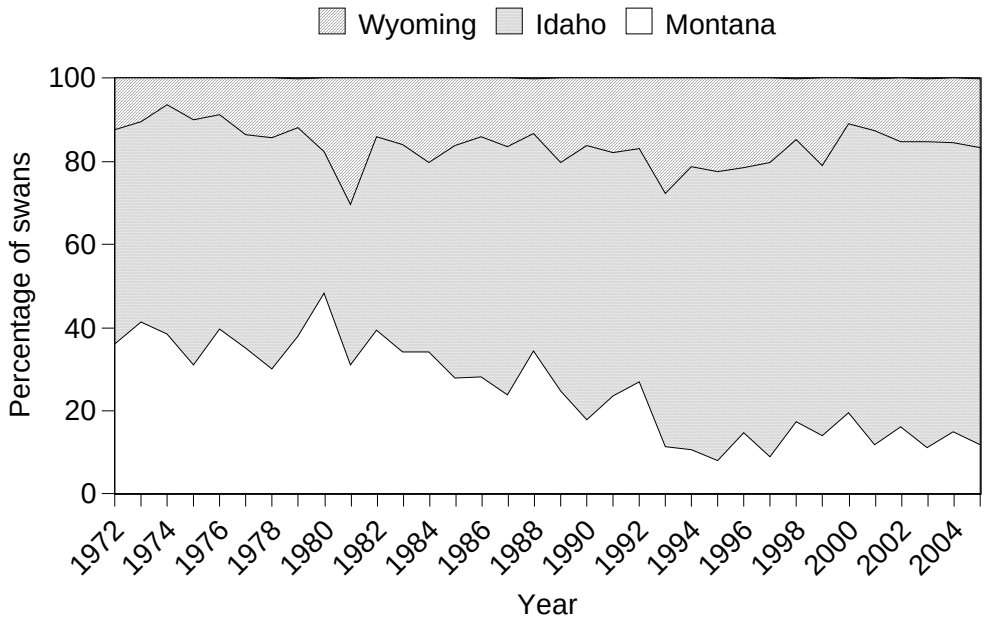

Fig. 7. Proportions of total swans counted in each of the states comprising the tri-state region during the Mid-winter Trumpeter Swan Survey, 1972-2005.

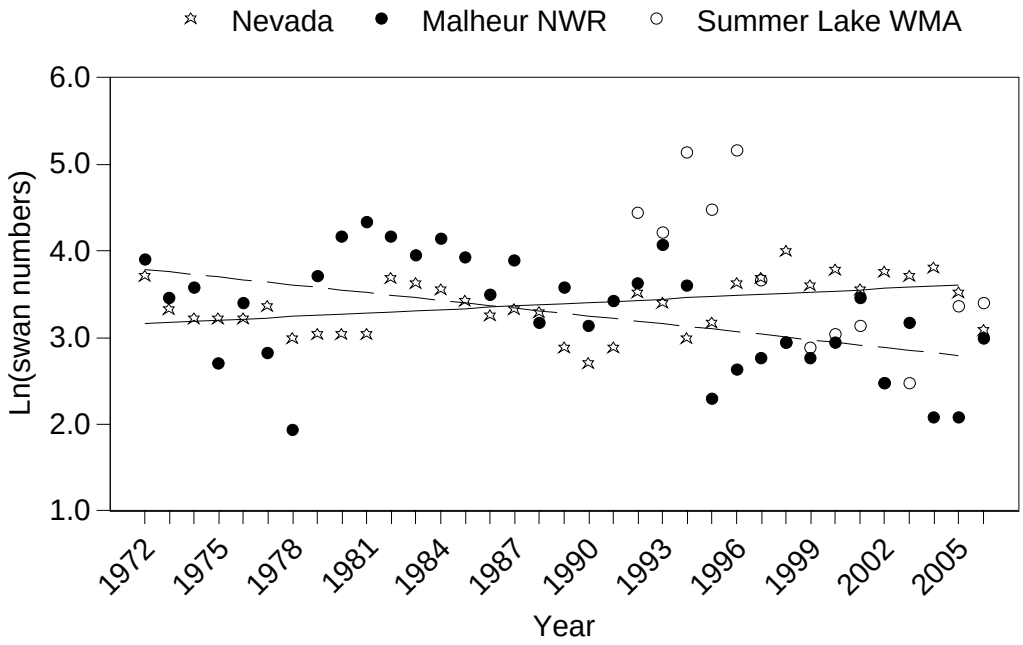

Fig. 8. Rates of change in counts of total swans in Nevada (stars and solid line) and Oregon (Malheur NWR [closed circles and dashed line] and Summer Lake WMA [open circles]) during the Mid-winter Trumpeter Swan Survey, 1972-2006. Data for Summer Lake WMA in 2002 and 2003 are from incomplete surveys.

Table 3. Estimates of swan abundance for flocks comprising the Rocky Mountain Population of Trumpeter swans, 1972-2006.

Year	Mid-winter count	U.S. Breeding Flocks[a]	Canadian Flocks	Percent Canadian Flocks
1972	707	572	135	19.1
1975	763	581	182	23.9
1978	901	544	357	39.6
1981	1345	582	763	56.7
1984	1558	547	1011	64.9
1985	1598	563	1035	64.8
1986	1662	575	1087	65.4
1987	1659	452	1207	72.8
1988	1773	611	1162	65.5
1989	1797	659	1138	63.3
1990	2045	598	1447	70.8
1991	1980	626	1354	68.4
1992	2196	555	1641	74.7
1993	2235	563	1672	74.8
1994	2524	354	2170	86.0
1995	2803	454	2349	83.8
1996	2936	427	2509	85.5
1997	2681	458	2223	82.9
1998	2156	427	1729	80.2
1999	3541	469	3072	86.8
2000	3524	417	3107	88.2
2001	4007	481	3526	88.0
2002	4427	487	3940	89.0
2003	3974	371	3603	90.7
2004	4584	417	4167	90.9
2005	5361	417	4944	92.2
2006	5484	510	4974	90.7

[a] From U.S. Fish and Wildlife Service 2005*a*. Counts are from the previous calendar year (e.g., the 2006 value is from the Fall 2005 survey).

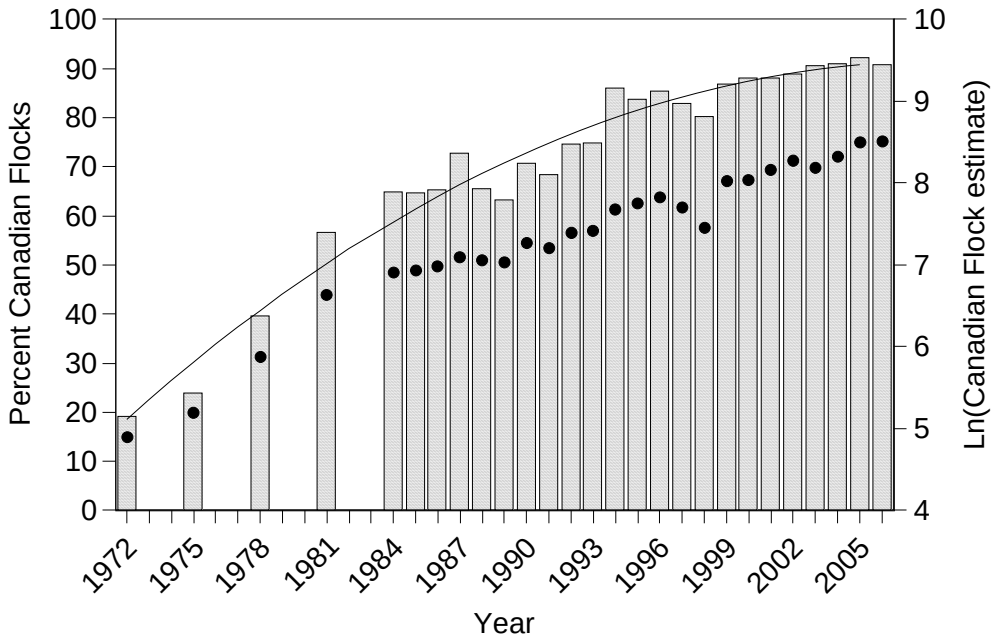

Fig. 9. Percent (bars and solid line) and counts (solid dots) of the entire RMP estimated to be comprised of Canadian Flocks during the Mid-winter Trumpeter Swan Survey, 1972-2006.

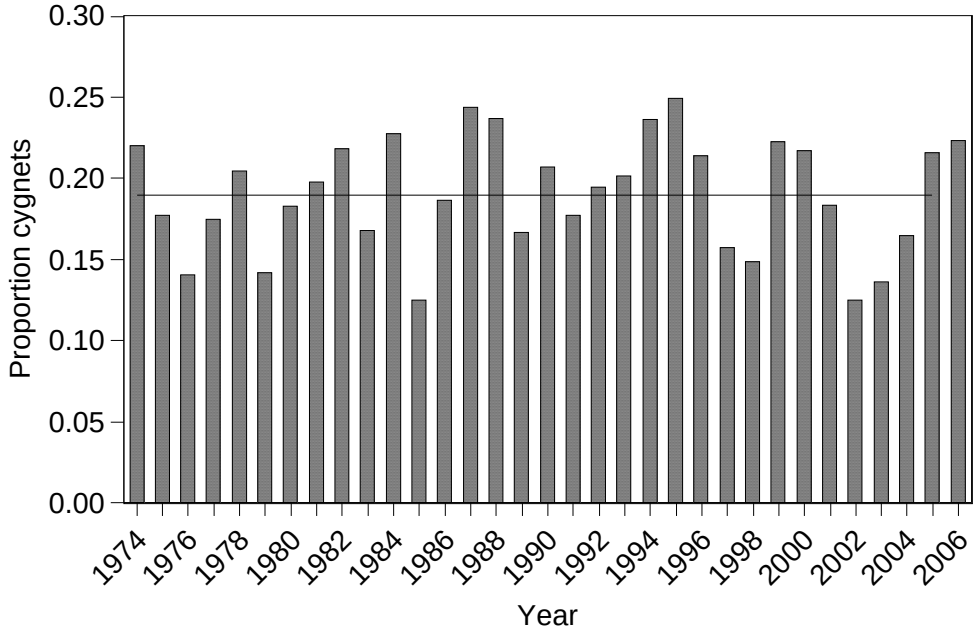

Fig. 10. Proportion of cygnets counted in the tri-state region during the Mid-winter Trumpeter Swan Survey, 1974-2006. The solid line depicts the 1974-2005 average.

was the third consecutive record-high count. Increases of total swans from counts in 2005 occurred in Montana (+47%) and Wyoming (+2%), but a slight decrease occurred in Idaho (-5%) (Table 2). In Montana and Wyoming, the number of birds this year were record-high counts, whereas that for Idaho was second only to the record-high count from last year. Of the birds wintering in the tri-state area during February 2006, about 17% were in Montana, 66% were in Idaho, and 17% inhabited Wyoming.

The number of swans in Nevada (22) was lower than counts in recent winters (Table 2), and about half that from a few years ago. No cygnets were observed during the survey this winter. The total count was 29% below the long-term average (31 swans). Warm weather resulted in small areas of open water, with only about 85% of the marsh area of Ruby Lake frozen. The number of swans counted at Malheur NWR (20) was greater than that of last year, but 39% below the 1972-2005 average (Appendix A). The count at SLWMA (30) was essentially the same as that of last year.

The estimated number of swans from Canadian Flocks was 4,974 birds, a value nearly identical to that of 2005. With the exception of 2003, successive estimates for the size of the Canadian Flocks since 1998 have been record-high counts. The estimate suggested about 91% of the RMP counted in February 2006 was comprised of swans from Canadian Flocks (Table 3, Fig. 9), nearly the same as the average proportion over the last few years.

In contrast to the estimate for the Canadian Flocks derived by subtraction, the count from the quinquennial survey was 4,718 swans (Moser 2006). Thus, the subtraction-method estimate was 5.4% higher than that from the rangewide survey. This result is similar to comparisons of the estimates from previous years when both surveys were conducted. On average, the subtraction method results in a estimates about 350 birds higher than those from the quinquennial surveys (Table 4). Assuming that counts are accurate, or at least that biases are constant over time, the difference could be due to the following: (1) the quinquennial rangewide survey does not count all of the Canadian swans on their nesting areas, (2) swans from outside the designated range of the RMP winter in areas surveyed annually for the RMP, or (3) a combination of these possibilities.

The proportion of cygnets for swans counted in the tri-state region during February 2006 was 0.223. This value was 18% above the 1974-2005 average (0.190) (Fig. 10). The 2006 Mid-winter proportion was the second consecutive year suggesting above-average production for the RMP.

In summary, RMP trumpeter swans appeared to increase by about 6.1% annually between 1972 and 2005. Most of the increase over that time was attributable to increases in the number of birds in the Canadian Flocks, which estimates suggest comprise slightly more than 90% of the population. Although estimates of the size of the Canadian Flocks from the winter RMP surveys typically are greater than those from the quinquennial surveys, the estimates appear to track each other. This result suggests that annual estimates of the size of the Canadian Flocks from the winter RMP surveys are reasonable, but may slightly overestimate their abundance.

Table 4. Comparison of estimates from annual RMP surveys and the quinquennial surveys, 1975-2005.

Year	Subtraction method from RMP surveys[a]	Quinquennial survey[b]	Difference
1975	c	131	c
1980	763	379	384
1985	1,087	614	473
1990	1,354	1,117	237
1995	2,509	2,076	433
2000	3,526	3,183	343
2005	4,974	4,718	256

[a]RMP winter count from year$_{t+1}$ minus RMP fall count from year$_t$ (e.g., 1980 estimate from 1981 RMP winter count minus 1980 RMP fall count).

[b]Estimates from Moser (2006).

[c]Estimate not available because 1975 RMP fall survey was not conducted.

The number of RMP swans increased 2% between the winters of 2004-05 and 2005-06. For the second consecutive year, production appeared to be above average for the RMP as a whole. The Canadian Flocks continue to increase in number, and our estimate was corroborated by the quinquennial rangewide survey this year. Also, the fall count of the RMP/U.S. Breeding Segment was the highest since 1992 (U.S. Fish and Wildlife Service 2005*a*). This continued improvement in the RMP is encouraging, although counts for the U.S. Breeding Segment remain well below objective levels. The increase in precipitation throughout U.S. nesting areas this winter, and subsequent improved water levels in reservoirs, should improve habitat conditions for swans this spring and summer.

ACKNOWLEDGMENTS

We would like to especially thank the personnel who conducted the surveys, a list of whom is provided in Appendix C. The survey is a collaborative effort among Red Rock Lakes NWR, Migratory Birds and State Programs -- Mountain-Prairie Region of the U.S. Fish and Wildlife Service, Southeast Idaho Refuge Complex, National Elk Refuge, Harriman State Park, Idaho Department of Fish and Game, Grand Teton National Park, Yellowstone National Park, Wyoming Game and Fish Department, Ruby Lake NWR, Malheur NWR, and the Shoshone-Bannock Tribes. J. Cornely, T. McEneaney, J. Mackay, C. Mitchell, S. Patla, R. Roy, M. St. Louis, and J. Warren provided comments and helpful suggestions for this document.

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Appendix A. Counts of trumpeter swans of the Rocky Mountain Population during winter, 1972-2006.

	Montana			Idaho			Wyoming (outside Yellowstone NP)		
Year	White birds	Cygnets	Total	White birds	Cygnets	Total	White birds	Cygnets	Total
1972	209	14	223	303	14	317	16	4	20
1973	212	28	240	222	58	280	a	a	a
1974	233	40	273	282	109	391	7	0	7
1975	192	32	224	333	94	427	40	2	42
1976	253	34	287	308	67	375	30	1	31
1977	315	43	358	395	126	521	86	0	86
1978	194	68	262	392	96	488	63	4	67
1979	304	26	330	353	81	434	15	3	18
1980	374	80	454	250	70	320	63	6	69
1981	352	36	388	370	110	480	37	10	47
1982	390	90	480	429	137	566	76	19	95
1983	363	59	422	493	122	615	81	12	93
1984	389	109	498	503	162	665	87	11	98
1985	393	31	424	701	144	845	78	8	86
1986	380	73	453	744	183	927	91	25	116
1987	314	63	377	690	255	945	85	18	103
1988	438	153	591	694	209	903	115	28	143
1989	342	90	432	817	141	958	197	39	236
1990	319	38	357	1025	300	1325	169	46	215
1991	385	70	455	918	211	1129	225	47	272
1992	438	114	552	892	249	1141	204	30	234
1993	168	70	238	1020	246	1266	293	64	357
1994	199	48	247	1164	397	1561	253	74	327
1995	153	61	214	1391	475	1866	327	91	418
1996	319	82	401	1336	390	1726	344	84	428
1997	204	30	234	1555	272	1827	346	102	448
1998	290	68	358	1200	200	1400	109	15	124
1999	335	153	488	1754	500	2254	317	71	388
2000	519	155	674	1881	513	2394	207	65	272
2001	373	96	469	2404	549	2953	368	63	431
2002	600	104	704	2636	357	2993	447	72	519
2003	375	58	433	2490	382	2872	354	58	412
2004	583	92	675	2591	563	3154	462	58	520
2005	508	119	627	2954	828	3782	561	166	727
2006	713	211	924	2714	873	3587	655	111	766

[a] Counts not available.

[b] Total counts not separated into white birds and cygnets prior to 1992.

[c] Swans first translocated to Summer Lake WMA in 1992.

[d] Count biased low because aerial survey not conducted due to hazardous weather; snowmobile count with incomplete coverage only.

[e] Count biased low due to incomplete survey coverage.

Appendix A. (cont.)

	Yellowstone NP			Malheur NWR[b]			Summer Lake WMA[c]			Nevada[b]		
Year	White birds	Cygnets	Total	White birds	Cygnets	Total	White birds	Cygnets	Total	White birds	Cygnets	Total
1972	a	a	56			50						41
1973	a	a	61			32						28
1974	31	7	38			36						25
1975	30	0	30			15						25
1976	32	0	32			30						25
1977	43	9	52			17						29
1978	46	11	57			7						20
1979	71	13	84			41						21
1980	80	16	96			65						21
1981	241	91	332			77						21
1982	57	20	77			65						40
1983	88	14	102			52						38
1984	149	50	199			63						35
1985	154	7	161			51						31
1986	89	18	107			33						26
1987	107	50	157			49						28
1988	67	18	85			24						27
1989	96	21	117			36						18
1990	78	32	110			23						15
1991	61	14	75			31						18
1992	108	4	112	25	13	38	42	43	85	32	2	34
1993	178	39	217	44	15	59	47	21	68	30	0	30
1994	137	24	161	30	7	37	84	87	171	13	7	20
1995	141	41	182	9	1	10	63	26	89	21	3	24
1996	130	24	154	11	3	14	129	46	175	23	15	38
1997	74	3	77	11	5	16	35	4	39	31	9	40
1998	157[d]	24[d]	181[d]	13	6	19	18	1	19	33	22	55
1999	292	48	340	a	a	16	16	2	18	29	8	37
2000	87	13	100	a	a	19	15	6	21	35	9	44
2001	53	11	64	a	a	32	16	7	23	31	4	35
2002	131	13	144	a	a	12	7[e]	5[e]	12[e]	41	2	43
2003	146	34	180	19	5	24	9[e]	3[e]	12[e]	34	7	41
2004	149	33	182	8	0	8	a	a	a	38	7	45
2005	124	30	154	8	0	8	19	10	29	32	2	34
2006	121	14	135	15	5	20	21	9	30	22	0	22

[a] Counts not available.

[b] Total counts not separated into white birds and cygnets prior to 1992.

[c] Swans first translocated to Summer Lake WMA in 1992.

[d] Count biased low because aerial survey not conducted due to hazardous weather; snowmobile count with incomplete coverage only.

[e] Count biased low due to incomplete survey coverage.

Appendix B. Site-specific counts of trumpeter swans of the Rocky Mountain Population during the Mid-winter Trumpeter Swan Survey, 2006.

State or Area	White birds	Cygnets	Total	Pilot/observer/notes
Montana				
Hebgen Lake area				P:R. Stradley; O:T. McEneaney (2/11/06)
Cougar Creek	0	0	0	
Between Quake Lake and Hebgen Lake	0	0	0	
Madison River Arm	416	116	532	
North Spring (Grayling Arm)	26	17	43	
South Fork Arm	61	20	81	
Subtotal	**503**	**153**	**656**	
Madison River Valley				P: D. Chapman; O: J. Warren (2/7/06)
Odell Creek Area	21	15	36	
Walsh Ponds (south)1	0	0	0	
Walsh Ponds (north)1	4	0	4	
Madison River, south of Ennis	0	0	0	
Madison River, north of Ennis	17	13	30	
Ennis Lake	102	20	122	
Subtotal	**144**	**48**	**192**	
Chain of Lakes				
Cliff Lake	1	0	1	
Wade Lake	0	0	0	
Goose Lake	0	0	0	
Smith Creek (Hidden Lake outlet)	0	0	0	
Subtotal	**1**	**0**	**1**	
Centennial Valley/Red Rock Lakes NWR				
Red Rock River below Lower Lake Dam	0	0	0	
MacDonald Pond	30	3	33	
Culver Pond	6	2	8	
Elk Springs Creek	0	0	0	
Swan Lake	0	0	0	
Shambow Pond	0	0	0	
Red Rock River, Lima	0	0	0	
Subtotal	**36**	**5**	**41**	
Paradise Valley				P:R. Stradley; O:T. McEneaney (2/11/06)
Armstrong's Spring Creek	3	2	5	
Bailey's	0	0	0	
Brockway	0	0	0	
DePuys	7	0	7	
Brandis	2	0	2	
Nelson's Spring Creek	0	0	0	

Appendix B. (cont.)

Sacagawea Park	0	0	0	
Yellowstone River 1 mile north of Emigrant	0	0	0	
Beaver Creek	16	3	19	
Yellowstone River - 6 mile	0	0	0	
Yellowstone River - Pray	0	0	0	
Dana's	1	0	1	
Subtotal	**29**	**5**	**34**	
Wyoming				
Upper Snake River (Flagg Ranch to Wilson Bridge)				P: D. Stinson; O: S. Patla (2/6-7/06)
Polecat Creek	1	0	1	
Flagg Ranch to Jackson Lake	0	0	0	
Jackson Lake	0	0	0	Frozen
Jackson Lake to Moran Junction	24	1	25	Pancake ice down from Oxbow; 16 swans downriver
Moran Junction to Deadman's	2	0	2	Pancake ice
Deadman's to Moose	28	0	28	Swans mostly in side channels
Moose to Gros Ventre Junction	9	1	10	
Gros Ventre Junction area	30	2	32	
Gros Ventre Junction to Wilson Bridge	16	2	18	
Gros Ventre River, Highway 89 to Snake River	0	0	0	Much ice; restricted flow
Subtotal	**110**	**6**	**116**	
Gros Ventre River upriver of Kelly				
Kelly Warm Springs, Grand Teton National Park	0	0	0	
Lower Slide Lake	0	0	0	
Upper Gros Ventre	0	0	0	
Subtotal	**0**	**0**	**0**	
Lower Snake River (Wilson Bridge to Alpine)				
Wilson Bridge to South Park Bridge	13	0	13	
Evan's Gravel pit ponds	58	14	72	
South Park Bridge to Hoback	0	0	0	
North Wilson	20	2	22	
Fish Creek, Wilson to Snake River	54	5	59	
Boyles Hill area	4	1	5	
Spring Creek	40	12	52	
Crane Creek	14	2	16	
Lower Flat Creek, Snake River to Jackson	17	5	22	
Rafter J Ponds	0	0	0	
Valley Springs, Captive Swan Pond/Pen Highway 89	0	0	0	
Hoback to Astoria Bridge	0	0	0	
Astoria Bridge-Elbow	20	2	22	Golf club development
Elbow to Alpine/Palisades Reservoir	4	0	4	

Appendix B. (cont.)

Bailey Lake	a			Not flown
Kelly Swan Facility	2	1	3	
Bondurant pond near Hoback River	0	0	0	4 swans reported this winter but none seen at survey
Subtotal	**246**	**44**	**290**	
National Elk Refuge				
Flat Creek main marsh	30	0	30	Includes wetland ponds
Gros Ventre River, Kelly to Highway 89	14	5	19	All on Bill's Bayou
Romney pond area	0	0	0	
Lost Spring	13	3	16	
Subtotal	**57**	**8**	**65**	
Salt River (Alpine to Afton)				
Palisades Reservoir, WY Alpine	6	0	6	
Palisades Reservoir to Freedom Road	14	10	24	3 adults with green collars
Freedom Road to Narrows	13	8	21	
Thayne area	3	0	3	Flat Creek pond
Narrows to Grover/Auburn Highway	22	6	28	
Grover/Auburn Highway to Swift Creek	66	13	79	
Swift Creek to Headwaters	0	0	0	
Subtotal	**124**	**37**	**161**	
Pinedale				
New Fork Boulder to Pinedale				
Boulder Fish Hatchery	4	0	4	Observed Feb. 9 by Sky Aviation
Daniel Fish Hatchery/Forty Rod Creek	18	6	24	
Subtotal	**22**	**6**	**28**	One green collar J38
Green River (Warren Bridge to Highway 28 Bridge)				
Fontenelle Dam-CCC Bridge	2	0	28	Open water
CCC Bridge to Pilot Farm	56	6	62	Not much ice
Pilot Farm-Refuge Headquarters	14	0	14	Ice increasing
Refuge to Big Sandy	2	0	2	Much pancake ice; river frozen by Dunkle wetlands
Big Sandy to Big Island	0	0	0	River >50% frozen except open pools
Big Island to Green River, WY	4	0	4	River frozen; open water near large plant
Flaming Gorge Reservoir	0	1	1	With 1 tundra swan; lower 1/3 of reservoir open
Subtotal	**78**	**7**	**85**	
Dubois area				
Wind River and spring ponds, Dubois	0	0	0	Flown by Sky Aviation
Dinwoody Lake	18	3	21	Ground count, P. Hnilicka, USFWS
Bull Lake	0	0	0	
Wind River, Crowhart to Burris	0	0	0	Not flown
Subtotal	**18**	**3**	**21**	

Appendix B. (cont.)

Yellowstone National Park				P:R. Stradley; O:T. McEneaney (2/11/06)
Slough Creek	0	0	0	
Tern Lake	6	0	6	
White Lake	2	1	3	
Beach Springs Lagoon	0	0	0	
Shoshone Geyser Basin	1	0	1	
Lewis River	0	0	0	
Buela Lake	4	0	4	
Yellowstone River	46	5	51	
Lewis - Shoshone Channel	4	0	4	
Lewis Lake	2	0	2	
Falls River	1	0	1	
Shoshone Lake	0	0	0	
Bechler Lake	4	0	4	
Firehole River	3	0	3	
Madison River	44	8	52	
Gibbon Meadow	2	0	2	
Nymph Lake	2	0	2	
Elk Park	0	0	0	
North Twin Lake	0	0	0	
Subtotal	**121**	**14**	**135**	
Idaho				P: C. Anderson, A. Issac; O: M. Fisher, C. Mitchell
Island Park Area				(1/30-31/06, 2/3/06)
Warm Springs (west side of Henrys Lake)				
Henrys Lake flats	1	1	2	
Big Springs, North Fork, Mack's Inn Area	8	0	8	
Mack's Inn to Island Park Reservoir	38	10	48	
Island Park Reservoir	0	0	0	
Island Park Reservoir inlet	7	0	7	
Trude Ranch Pond				Counted on Buffalo River Area
Icehouse Reservoir	2	0	2	
Sheridan Creek, mouth to Sheridan Reservoir				Not flown; 11/10 observed on 2/6/06
Sheridan Reservoir	16	7	23	
Sheridan Creek cabin and pond	0	0	0	
Subtotal	**72**	**18**	**90**	
Buffalo River Area				
Buffalo River	2	0	2	
Tom's Creek	5	0	5	
Elk Creek/Trudes Siding pond	21	1	22	
Subtotal	**28**	**1**	**29**	
Harriman State Park (HSP) Area				
Island Park Dam through Box Canyon	10	5	15	

Appendix B. (cont.)

Box Canyon - HSP north boundary	80	14	94	
HSP north bounday - Osborne bridge	234	56	290	
Golden Lake	17	6	23	
Thurmon Creek	0	0	0	
Silver Lake	0	0	0	
Osborne Bridge - Pinehaven	123	28	151	
Pinehaven	46	5	51	
Fish Pond	0	0	0	
Henrys Fork below Pinehave - Forest boundary	18	7	25	
Subtotal	**528**	**121**	**649**	
Henrys Fork, HSP to Warm River				
Warm River	0	0	0	
Subtotal	**0**	**0**	**0**	
Lower Henrys Fork Area				
Forest boundary to Ashton Dam	0	0	0	
Ashton Dam to Chester Dam	85	37	122	
Chester Dam to Highway 33	0	0	0	
Highway 33 - Menan Buttes	212	81	293	
Ashton Ponds	0	0	0	
Willow Creek Area farmstead ponds	24	8	32	
Mikesell Reservoir 1 & 2	0	0	0	
Arcadia Reservoir, Upper	0	0	0	
Arcadia Reservoir, Lower	0	0	0	
Sand Creek WMA and area	0	0	0	
Singleton Ponds	0	0	0	
Texas Slough	0	0	0	
Bannock Jim Slough	0	0	0	
Mud Lake WMA	0	0	0	
Camas NWR	0	0	0	
Camas Creek	0	0	0	
Subtotal	**321**	**126**	**447**	
Teton River Basin				
Teton River to Wilford Dam	142	60	202	
Wilford Dam to Newdale Bridge	157	28	185	
Newdale Bridge to Teton Dam site	90	19	109	
Teton River Canyon	82	22	104	
Teton Basin	125	50	175	
North Fork Teton River	0	0	0	
South Fork Teton River	0	0	0	
Subtotal	**596**	**179**	**775**	
South Fork of the Snake River				
Swan Valley (Palisades Reservoir to Conant Valley)	278	128	406	
Canyon (Conant to Heise)	51	30	81	

Appendix B. (cont.)

Delta (Heise to Menan Buttes)	8	10	18	
Dry bed (Heise to Menan)	0	0	0	
Subtotal	**337**	**168**	**505**	
Main Stem of the Snake River				
Menan B uttes to Idaho Falls	334	124	458	
Dry Bed	0	0	0	
Idaho Falls to Fort Hall (Ferry Butte)	10	7	17	
Blackfoot Marsh	0	0	0	Frozen
Subtotal	**344**	**131**	**475**	
Fort Hall Bottoms to American Falls Reservoir				
American Falls Reservoir shoreline	220	70	290	
Kinney Creek	0	0	0	
Mouth of Portneuf River	120	21	141	
Spring Creek to American Falls Reservoir	35	16	51	
Snake River - Tilden Bridge	0	0	0	
Clear Creek and Ross Fork	10	8	18	
Diggie Creek	0	0	0	
Flying Y oxbows	0	0	0	
Subtotal	**385**	**115**	**500**	
Snake River below American Falls Dam				
Springfield Reservoir	6	5	11	
American Falls Reservoir (except Fort Hall)	0	0	0	
American Falls Dam - Minidoka NWR	6	0	6	
Minidoka Dam - C.J. Strike Reservoir				
Bruneau Dunes State Park				
Bruneau Dunes - C.J. Stike Reservoir				
Faulkner Pond				
White Arrow Pond (Bliss)				
Pioneer Reservoir (King Hill)				
Silver Creek (Picabo area)	0	0	0	
Subtotal	**12**	**5**	**17**	
Grays Lake NWR Area				
Big Springs	0	0	0	
Shorty's Homestead	0	0	0	
Blackfoot Reservoir	20	0	20	
Chub Springs, southwest of refuge	0	0	0	
Chesterfield Reservoir				
Subtotal	**20**	**0**	**20**	
Soda Springs Area				
Woodall Springs	6	0	6	

Appendix B. (cont.)

Alexander Reservoir and Siding	0	0	0	
Miller Ponds	0	0	0	
Government Dam	9	1	10	
Soda Creek	0	0	0	
Soda Canal				
Subtotal	**15**	**1**	**16**	
Bear River Reaches				
Alexander Reservoir - Bear Lake NWR	0	0	0	
Alexander Reservoir - Gentile Valley Bridge	10	0	10	
Gentile Valley Bridge - old cheese factory	0	0	0	
Gentile Valley Bridge to Oneida Dam	31	4	35	
Oneida Narrows	0	0	0	
Oneida Narrows to Riverdale Bridge	0	0	0	
Riverdale Bridge to Utah border	4	0	4	
Subtotal	**45**	**4**	**49**	
Bear Lake National Wildlife Refuge				
West Canal Unit	11	4	15	Total for all three areas
Rainbow Unit	0	0	0	
Outlet Canal	0	0	0	
Subtotal	**11**	**4**	**15**	
Nevada				J. Mackay (2/8/06)
Ruby Lake NWR	22	0	22	
Oregon				
Malheur NWR				R. Roy (1/30-31/06, 2/1-3/06)
Benson Pond	15	5	20	Total for Refuge, not this specific area
Knox Swamp				
Mud Creek Pond				
Summer Lake Wildlife Management Area				M. St. Louis (1/25/06)
Summer Lake WMA	21	9	30	

[a]Blank denotes area not surveyed.

Appendix C. Personnel who conducted the 2005 Mid-winter Trumpeter Swan Survey.

Montana (Red Rock Lakes NWR, Centennial Valley, Madison Valley)
Observers: J. Warren (Red Rock Lakes NWR)
Pilot: D. Chapman (Montana Aircraft, Inc.)

Montana (Hebgen Lake Area and Paradise Valley)
Observer: T. McEneaney (Yellowstone National Park)
Pilot: R. Stradley (Yellowstone National Park)

Idaho
Observer: M. Fisher, C. Mitchell (Southeast Idaho Refuge Complex)
Pilot: C. Anderson, A. Issac (AvCenter)

Wyoming
Observer: S. Patla (Wyoming Game and Fish Department)
Pilot: D. Stinson (Sky Aviation)

Wyoming (Yellowstone National Park)
Observer: T. McEneaney (Yellowstone National Park)
Pilot: R. Stradley (Yellowstone National Park)

Ruby Lake NWR and vicinity
J. Mackay (Ruby Lake NWR)

Malheur NWR
R. Roy (Malheur NWR)

Summer Lake WMA
M. St. Louis, (Oregon Department of Fish and Wildlife)